(12) UK Patent Application (19) GB (11) 2 259 536 (13) A

(43) Date of A publication 17.03.1993

(21) Application No 9216939.0

(22) Date of filing 10.08.1992

(30) Priority data
(31) 913567 (32) 10.09.1991 (33) NO

(71) Applicant
Kvaerner Rosenberg A.S.

(Incorporated in Norway)

Rosenberg Verft, Skipsbyggergt. 20, N-4000 Stavanger, Norway

(72) Inventor
Hakon Pedersen

(74) Agent and/or Address for Service
Boult Wade & Tennant
27 Furnival Street, London, EC4A 1PQ,
United Kingdom

(51) INT CL[5]
E02B 17/00

(52) UK CL (Edition L)
E1H HEA

(56) Documents cited
None

(58) Field of search
UK CL (Edition K) E1H HB HEA HEB
INT CL[5] E02B
Online databases: WPI

(54) **Constructing and positioning structures and modules on an offshore platform**

(57) When assembling an offshore platform module supporting structures (11, 12) are first brought in to place between columns 1-4 by means of a barge, thereafter equipment modules (13) are loaded into place on the module supporting structures (11, 12) by means of a further barge, and then a substructure (15) is brought in between the columns (1-4) of the offshore construction by another barge, below the equipment modules (13) and level with the module supporting structures (11, 12) which are already installed.

Fig. 10

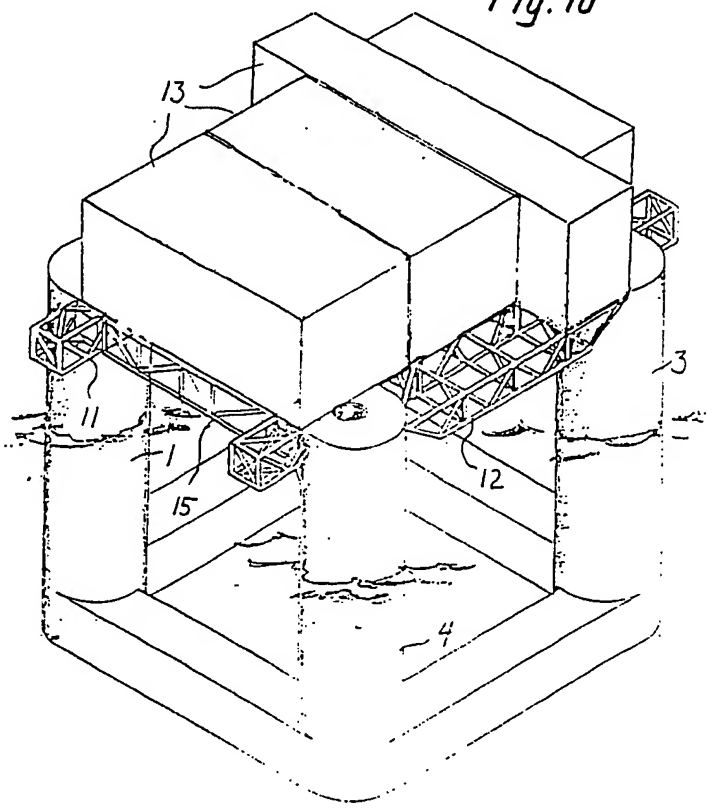

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Fig. 1

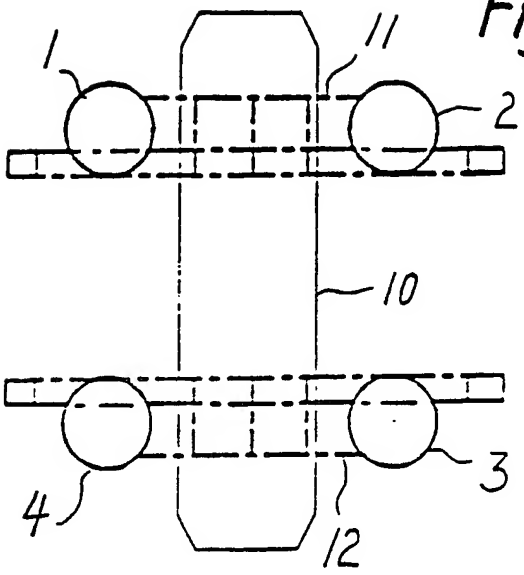


Fig. 2

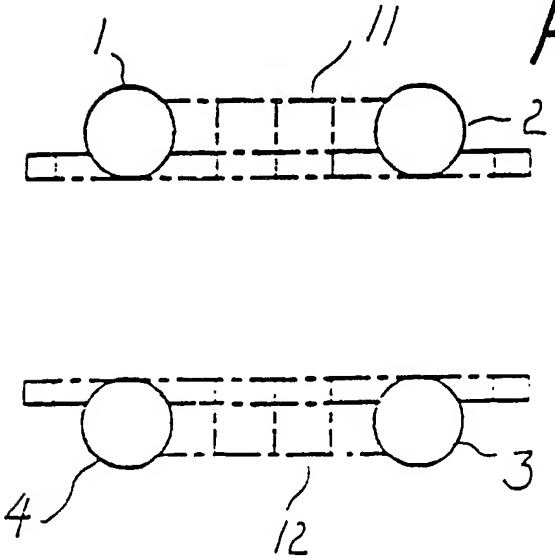


Fig. 3

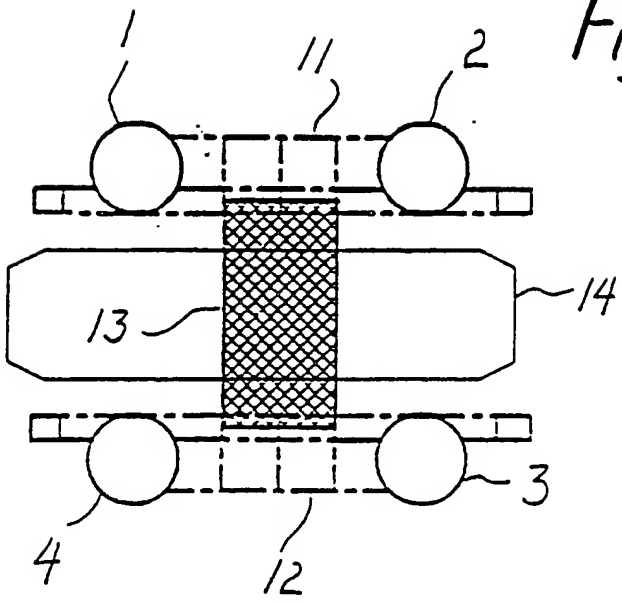
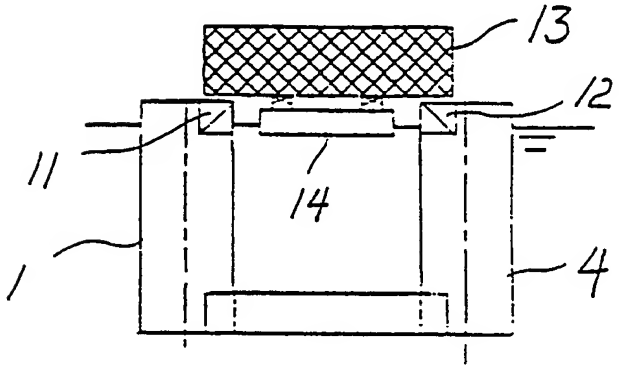


Fig. 4



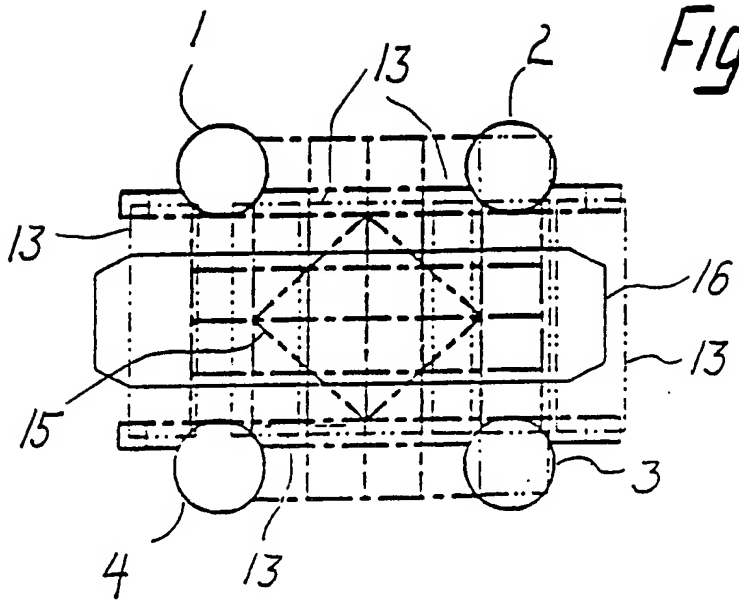


Fig. 5

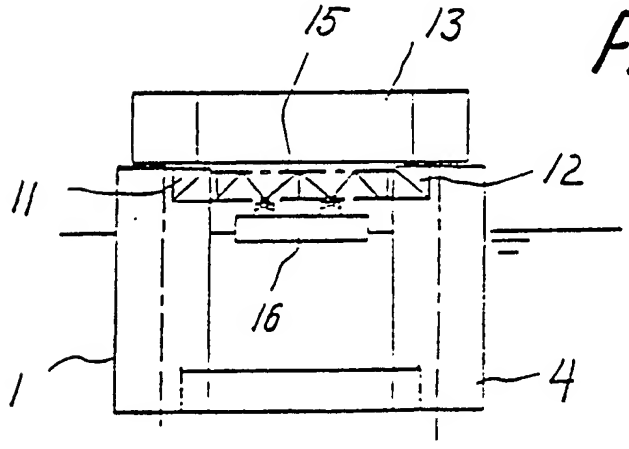


Fig. 6

Fig. 7

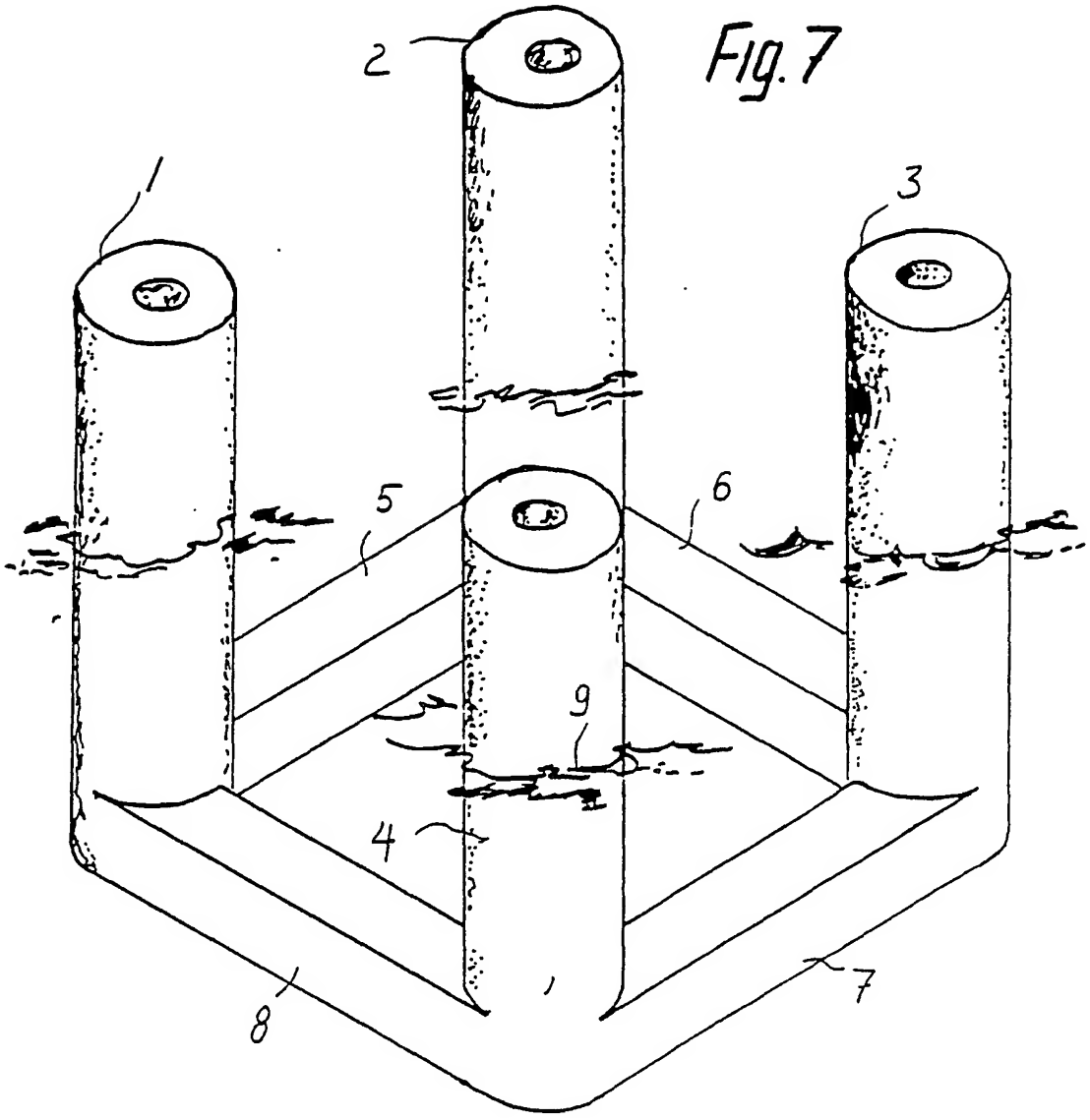


Fig. 8

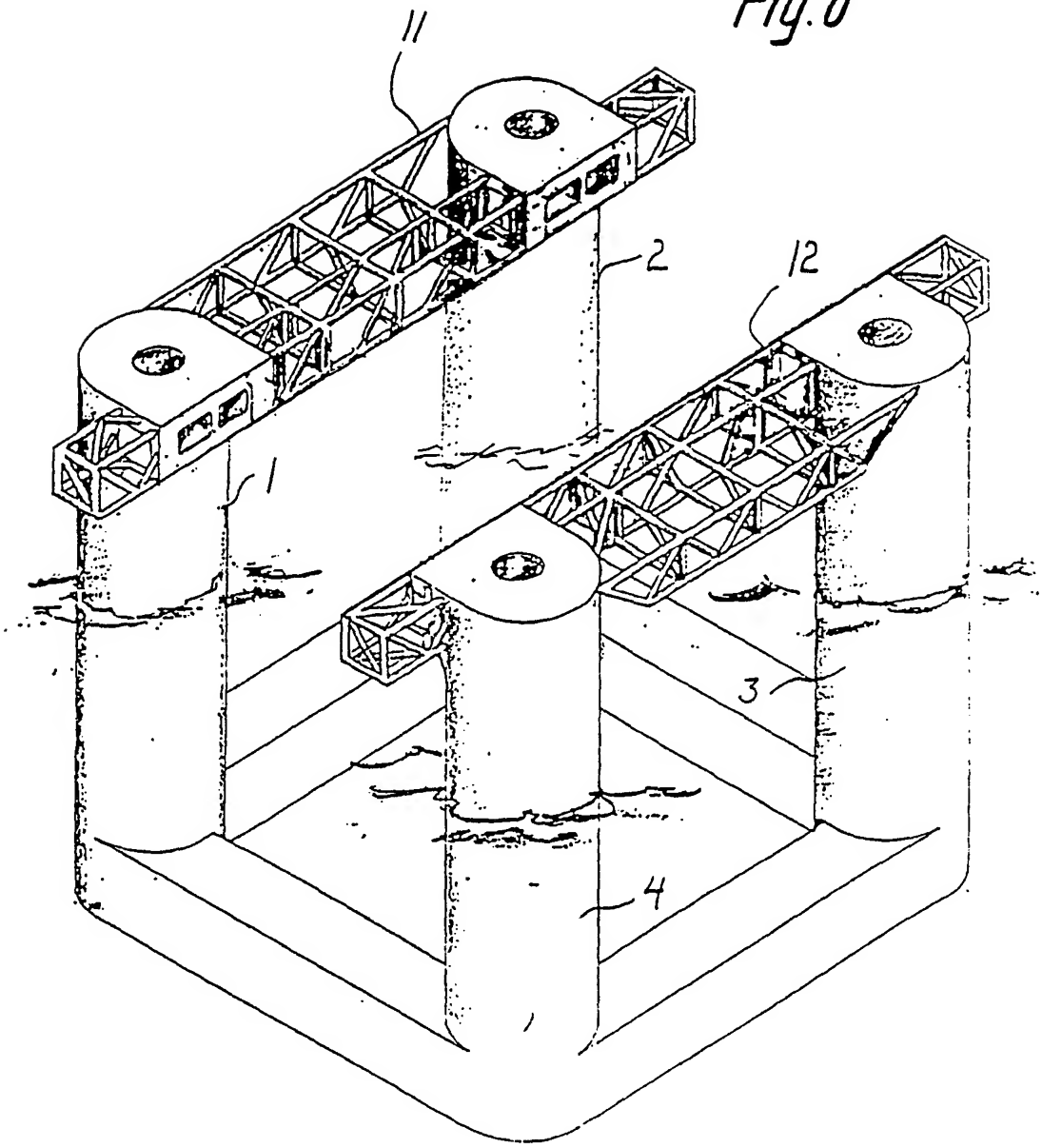


Fig.9

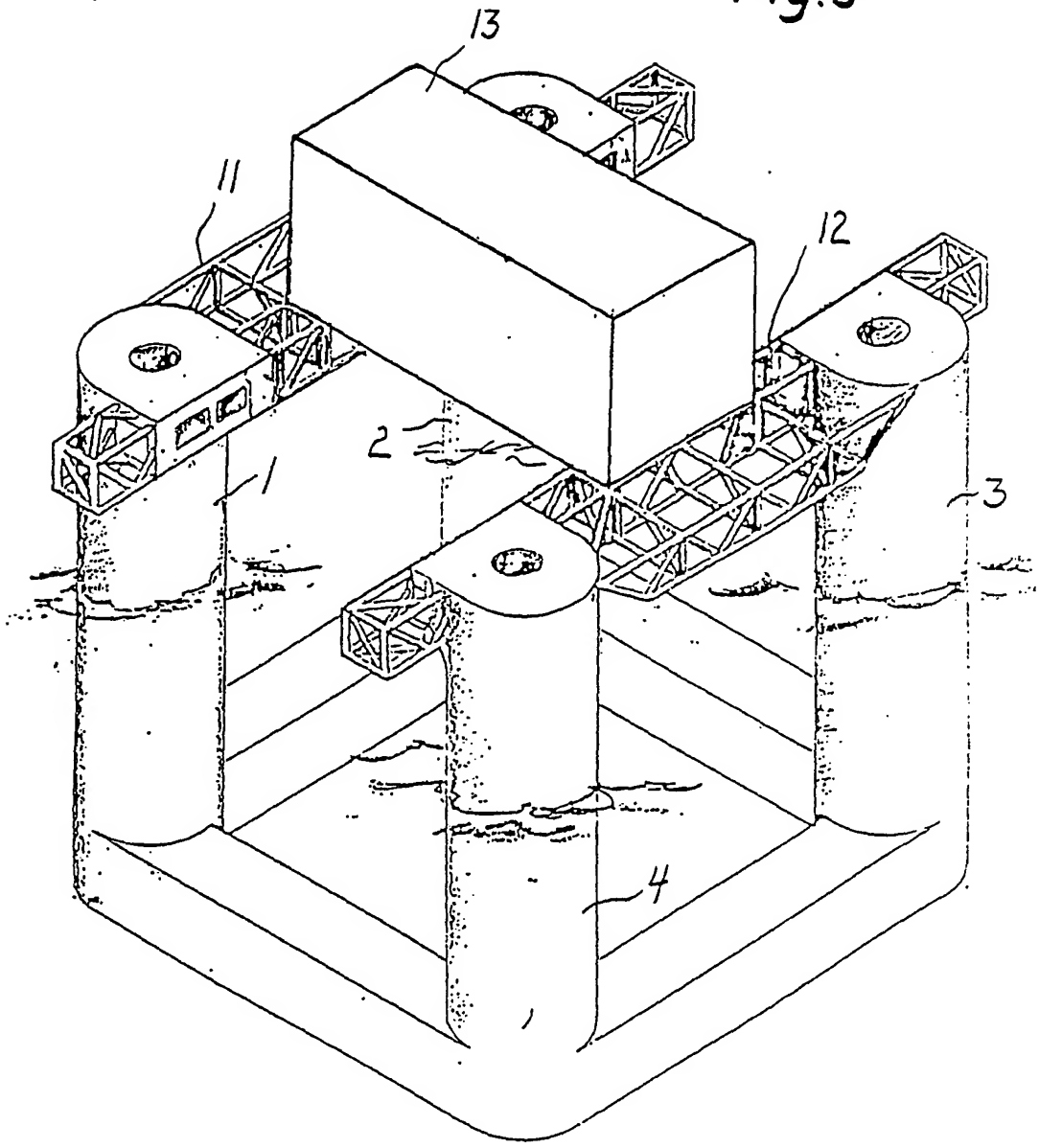


Fig. 10

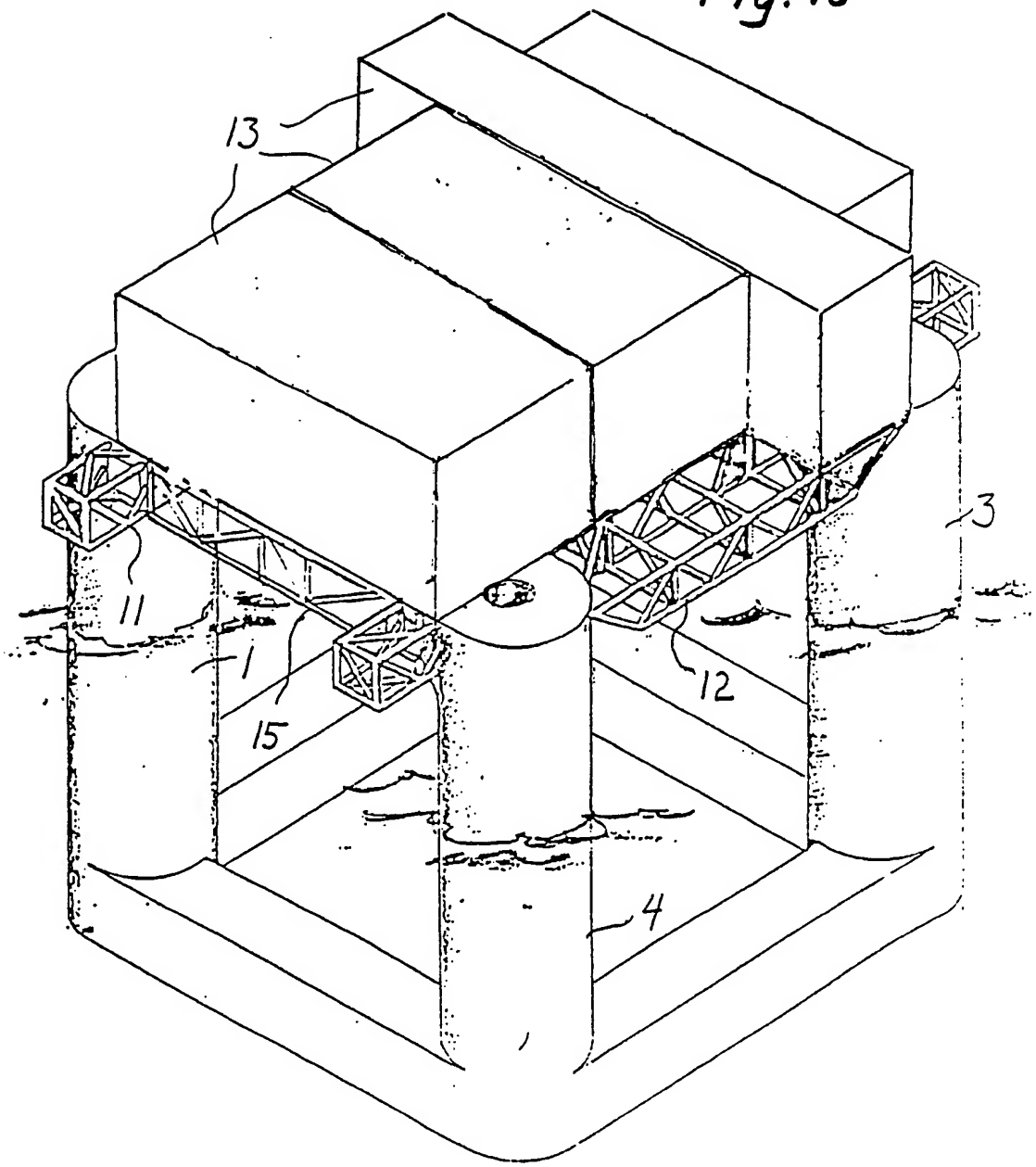


Fig. 11

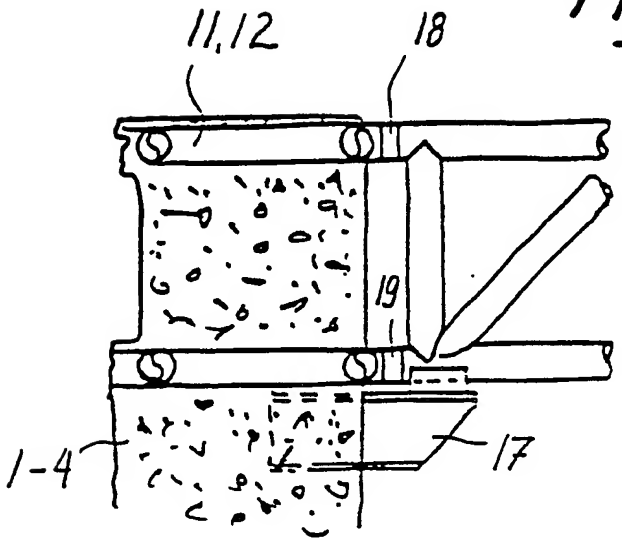


Fig. 12

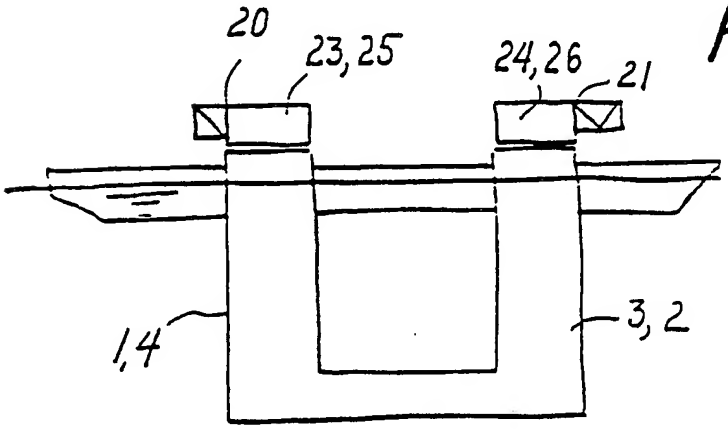


Fig. 13

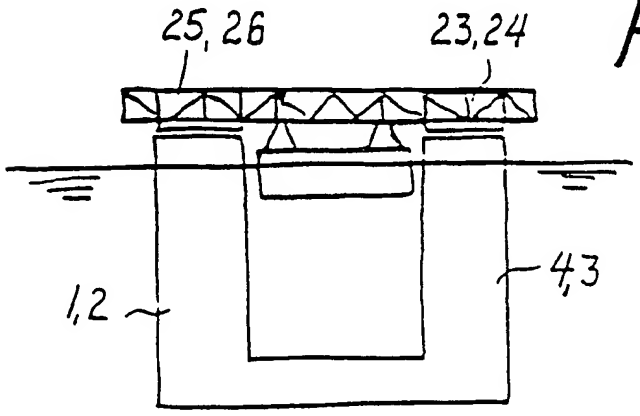


Fig. 14

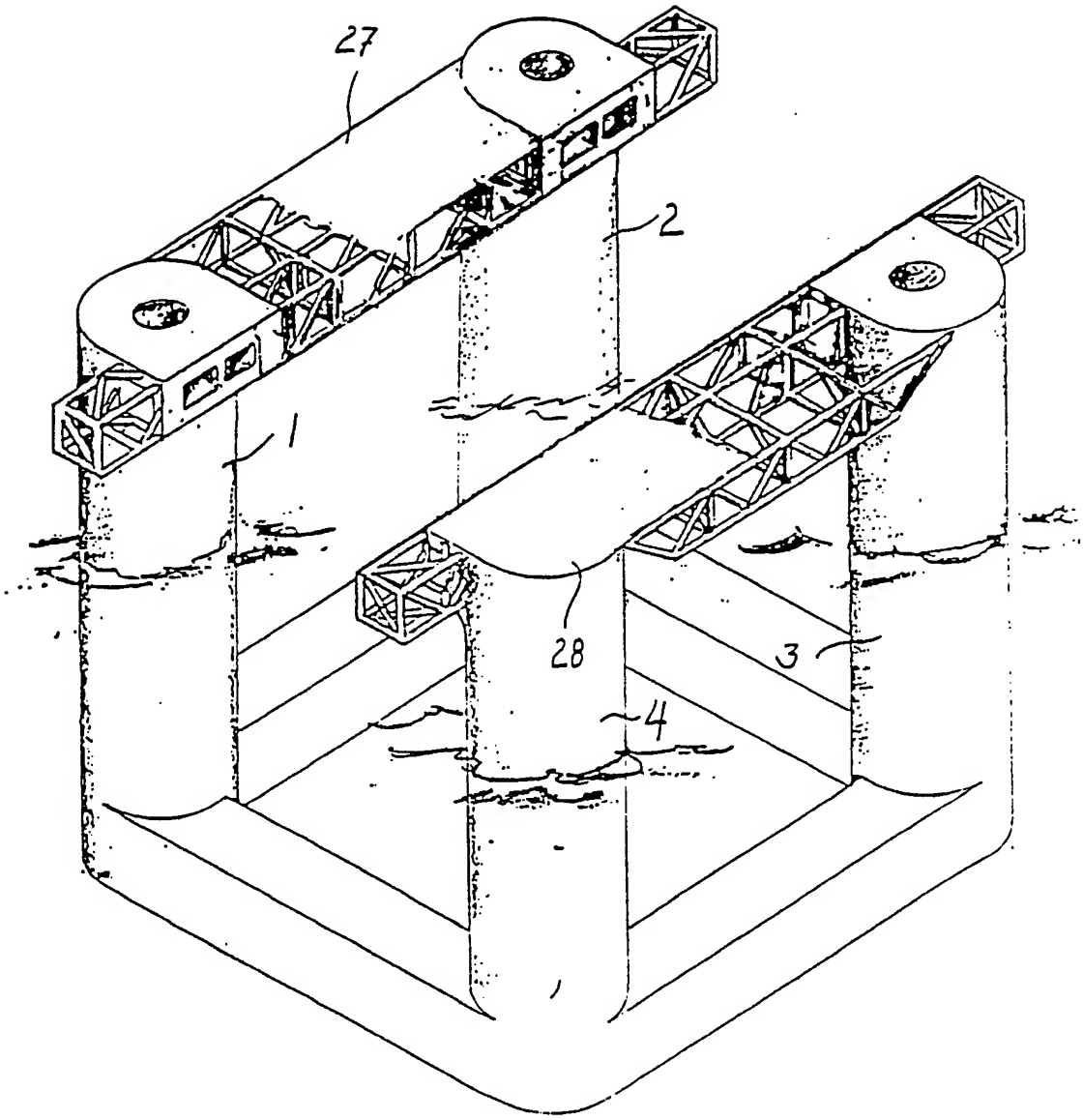


Fig. 15

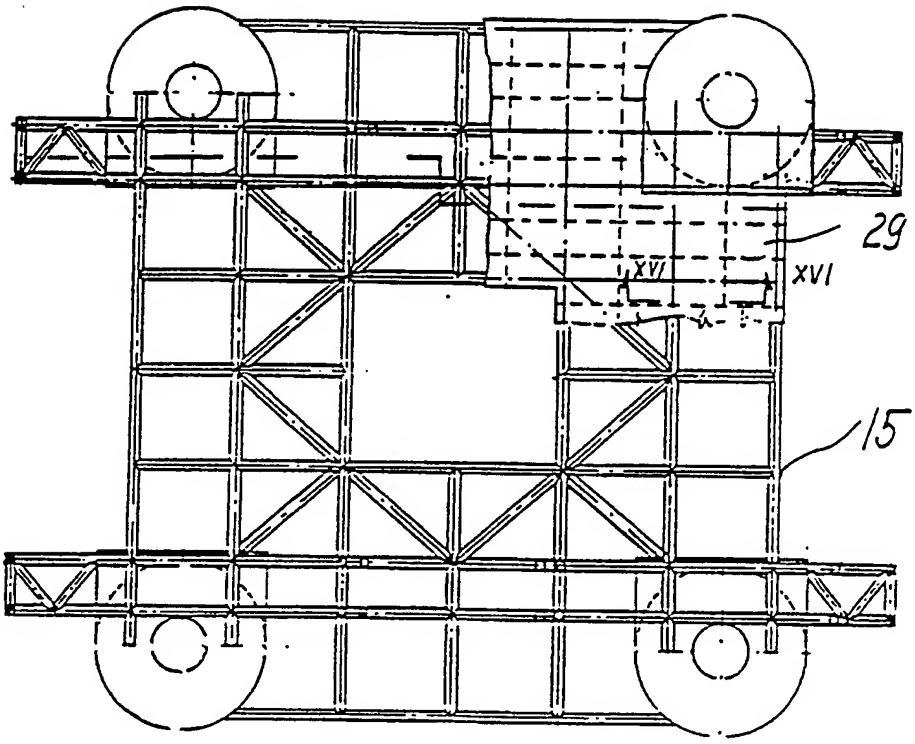


Fig. 16

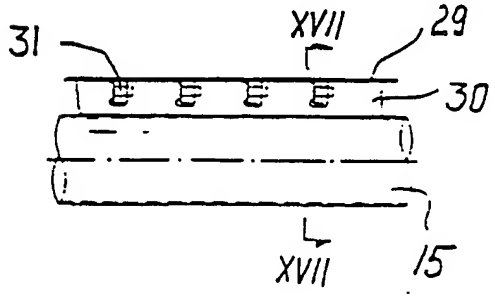
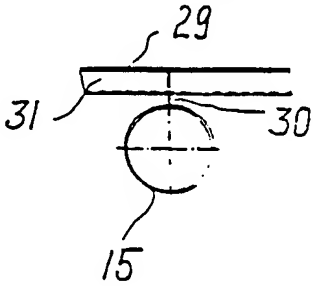


Fig. 17



METHOD OF CONSTRUCTING AND POSITIONING MODULE SUPPORTING STRUCTURES AND EQUIPMENT MODULES ON AN OFFSHORE CONSTRUCTION

The invention relates to a method of constructing and positioning module supporting structures and equipment modules on an offshore construction, which comprises columns or legs which project up through the surface of the water, by using barges for transport and installation.

A customary way of arranging drilling and processing platforms both floating and stationary, is to construct self-supporting modules which are placed on or above the structural support system of the platform, both the modules and the support systems being "tailor-made" to suit the special characteristics and needs of each oil field. This solution is functional and rational on several counts, but is not very flexible. The removal of the modules in order to enable alternative use can involve expensive reconstruction of the structural systems, both global and local, of the platform.

In a so-called "flat top" embodiment, the structural support systems of the platform are based on small modules, where consequently the bearing or support of the modules is also more compact, flexible and selectable. This also implies that the original modules can be removed from the platform and replaced with other types of modules without any substantial modification to the support systems, in such a way as to be able to meet the needs for alternative use of the platform. Such needs may be related either directly to the stationary period in which, for example, experience gained in respect of the exploitation of the field makes demands other than those first supposed, or the platform could be used in other oil fields which make different demands on the equipment. This last-mentioned possiblity applies only to floating or semi-submersible platforms, ie, for both moored and tension leg platforms.

The use of large lifting vessels for loading the heavy self-supporting equipment modules is very expensive. It is much

cheaper to use barges for loading of this kind, and this has therefore been introduced and will be introduced in the case of several platforms in the future.

In connection with Conoco's Heidrun platform, a concept is known which is based on self-supporting equipment modules being loaded on to a barge transverse thereto, and being positioned on module supporting structures which extend between respective pairs of columns. This method of loading requires free passage between the columns for the barge. Since, however, the columns are exposed to considerable stress from, amongst other things, waves and oceanic current, the self-supporting equipment modules will be placed above the open area between the columns, and must also function as global reinforcing members to maintain these columns in a fixed position in relation to one another.

Since this also applies to the forces of waves and current which have an effect on the columns diagonally, the equipment modules must also be capable of preventing the columns from deforming in relation to one another from a quadratic centre position to a parallelogram position.

The equipment modules which are directly above the columns must prevent this parallelogram deformation by the transfer of momentum from one pair of columns to the other. This stabilizing momentum and momentum of maintenance act together as a combined force from the substructures between the modules and the columns. This implies that the modules which, in this manner, contribute to the global strength of the platform, must have specially reinforced base structures.

A known solution of a pure "flat top" deck is one in which a deck is constructed so as to extend between all the columns. In this case there is no open space between the columns to allow access for the barges whilst loading modules, and this therefore calls for the loading of said modules by means of a

crane ship, possibly by means of lifting tackle belonging to the platform.

The purpose of the invention is to make possible a construction of the top section of an offshore construction (platform) in which barges may be employed to the full and in which the equipment modules do not have to be incorporated in the global strength of the platform.

According to the invention, a method of constructing an offshore construction is therefore proposed which comprises columns or legs projecting up through the surface of the water which are reinforced in relation to one another above the surface of the water by means of a substructure, and which further comprises module supporting structures on at least two pairs of adjacent columns and equipment modules supported on said module supporting structures, characterized in that the substructure is brought in between the columns by means of barges, below the equipment modules which are already in position and level with the previously installed module supporting structures, to which it is then connected.

In this way the use of barges is made possible for all three of the said main components: module supporting structures, equipment modules and substructure. The invention can therefore also be achieved as a method in which module supporting structures are brought into position on at least two pairs of adjacent columns by means of barges, whereupon the equipment modules are loaded in position on the module supporting structures by means of barges, and then the substructure is brought in between the columns by barge so that it is below the equipment modules and level with the previously installed module supporting structures, to which it is then connected, thereby being incorporated into the global structure of the offshore construction.

According to the invention, it is therefore proposed that

module supporting structures are brought into position on at least two pairs of adjacent columns by means of a barge, that thereafter the equipment modules are loaded in position on said module supporting structures by means of a barge, and then the sub- structure is brought in between the columns by barge, so that it is below the equipment modules and level with the already installed module supporting structures to which it is connected.

As a result of connecting a substructure which is integrated with the module supporting structures, the equipment modules above the columns need not be incorporated in the global strength. The compact lower section of the equipment modules can therefore be simplified and the modules will be lighter in weight and cheaper.

A more structurally surveyable fixing of the columns is also attained as the transfer of forces via diverging, flexible members, which are exposed to bending force and cutting force ,is avoided. Indirect transfer of force has been shown to give unforseen stress late in the projecting phase, and has created problems of modification for the constructors.

The equipment modules can be loaded off the offshore construction or platform without its global strength being affected. When the need arises, all the modules can therefore be removed and the underlying deck structure could then function as a flat weather deck.

The module supporting structure can be placed on the columns and connected thereto in several ways. For instance, the module supporting structures can advantageously be supported temporarily by the columns and be cemented to the respective columns.

The substructure can also advantageously be supported temporarily on the columns, prior to it being secured to or

connected to the module supporting structures.

Particularly advantageous is the fact that the substructure may be attached to the module supporting structures by welding in of loose parts (make-up pieces).

As mentioned, because they do not contribute to the global strength of the rig, the equipment modules could be loaded off without there being any effect on said global strength. It will be a question of cost optimization whether or not, on using the underlying deck structure as a flat weather deck, the necessary deck plate with reinforcements should be installed at the same time as the substructure, or whether a deck plate of this kind should be installed after the module has been removed.

The new method according to the invention, provides the possibility of using both methods. Here it shall be emphasized that the invention provides the possibility of furnishing the module supporting structures with an overlying deck plate prior to the equipment modules being loaded into place, and similarly the substructure can be furnished with an overlying deck plate (with reinforcement) before it is brought into place by barge between the columns.

The invention shall now be explained in more detail with reference to the drawings, where:

Figs 1-6 illustrate purely schematically the various stages in the execution of the method according to the invention;

fig. 7 shows a perspective outline of an offshore construction where the method according to the invention can be employed;

fig. 8 shows the offshore construction from figure 7

after the installation of the module supporting structures;

fig. 9 depicts the offshore construction from figure 7 and 8 after the positioning of an equipment module;

fig. 10 shows the offshore construction from figures 7, 8 and 9 after the final positioning of the sub-structure between the module supporting structures;

fig. 11 shows an enlarged detail taken from area XI in figure 10;

figs 12-13 show in a simplified outline at right angles to one another a modified embodiment of the module supporting structures;

fig. 14 shows an outline corresponding to figure 8, wherein the installed module supporting structures are furnished with a deck plate;

fig. 15 shows a top view of an offshore construction built up according to figures 7-10 and 14, and depicts the flat top version after the equipment module has been removed;

fig. 16 shows an enlarged section according to the section line XVI-XVI in figure 15;

fig. 17 shows a section according to the section line XVII-XVII in figure 16.

In the schematic basic outline in figure 1, there are four columns, 1, 2, 3, 4 in the offshore construction shown, see also figure 7. The columns or legs 1-4 are, as shown in figure 7, connected to each other by means of horizontal members 5, 6, 7, 8 which are submerged, whilst the columns as shown project up through the surface of the water 9. Between the columns 1-4 there is a free passage, and, as shown in figure 1, a barge may therefore be brought in between said columns. Placed on the barge are two module supporting structures 11, 12.

Said module supporting structures 11, 12 are purpose built above dock and lifted from the dock by means of the barge 10 and positioned between the columns 1-4 as illustrated in figure 1. The module supporting structures 11, 12 are constructed as a trusswork of pipes, see figure 8, but other forms of construction may be used. The module supporting structures can be mounted expediently on temporary support brackets (not shown) on the columns, whereupon loose pieces are fitted and welded in. The top of said columns 1-4 may thereafter be cast in their finished form (here it is assumed that the columns are made of concrete), in such a way that the module supporting structures are attached to the columns as shown in figures 2 and 8.

It is, of course, not a requirement that the columns or legs 1-4 be made of concrete. The invention can in the same way be achieved in connection with columns or legs made in the form of steel structures.

After preparatory steps are completed, for instance as shown in figures 2 and 8, the equipment modules are loaded on to the module supporting structures.

The equipment modules are usually in the form of large container-like constructions which can either be closed or in the form of more or less open frame-like structures, which are self-supporting. An equipment module of this kind is shown in figures 3 and 4, and is also drawn in figure 9, which illustrates an offshore construction in a perspective outline, in conformity with the sequence of figures which starts with figures 7 and 8 and ends with figure 10.

From figures 3 and 4 it can be seen how an equipment module 13 is placed on a barge 14 and brought in between the columns 1-4, where equipment supporting structures 11, 12 are brought into place as decribed above. In figure 9 it can be seen how the equipment module 13 is brought into place above the module

supporting structures 11, 12 and rests thereon.

Here it shall be observed that the actual transfer from the barge to the columns/module supporting structures is neither shown nor described in more detail, as this concerns well known technique.
Thus the ballasting of the barges and/or the float (offshore construction) can be used and special hoisting tackle on the barge can also be used, as well as buffer/receiver bodies on the columns/structures.

A substructure which is to be positioned between the columns and connected to the module supporting structures, is built preferably parallel to the module supporting structures and, similarly, above dock. As is the case for the module supporting structures, such a substructure 15 is loaded off the building dock by means of a barge 16, and is positioned in between the columns 1-4 as shown in figures 5 and 6. Said substructure 15 is positioned as shown between the columns from the under side of the equipment modules 13 (after placing module 13 as shown in figures 3, 4 and 9, additional modules are placed on the equipment supporting structures 11, 12 according to need, see figures 5 and 10) and level with the already installed module supporting structures 11, 12, they are adjusted and welded in position.

The substructure 15 is placed expediently on temporary support brackets 17 on the columns 1-4 by means of loose inserts (short pieces of piping) 18, 19 which are welded, after adjustment, to the equipment supporting structures 11, 12. A similar technique may, of course, be used for placing and connecting the module supporting structures 11, 12 on the columns.

In figures 12 and 13 a possible modified embodiment is illustrated, where, by using the concrete construction depicted in figure 7 as a basis, module supporting structures 20, 21 can be moved in by barge. These structures are made basically in

the same way as the structures 11, 12, but are modified thus that in each structure two steel cylinders 23-26 are integrated, which are put on top of the columns 1-4 which are cast in concrete.

These steel cylinders may be adjusted and mounted in a suitable fashion on the top of the respective columns. The use of steel cylinders which are put on the flat upper sides of the concrete columns represent a favourable technical solution because a certain degree of lateral divergence may be allowed, when the diameter of the concrete columns is somewhat greater than the diameter of the steel cylinders.

Above is described the construction of the top of the platform, with the module supporting structures, the equipment modules and the substructure, without a deck plate being inserted in advance. It will, as mentioned previously, be a question of cost optimization whether a possible overlying deck plate with reinforcement shall be installed at the same time as the sub-structure, or after the equipment modules have been removed. Figure 14 illustrates how a deck 27, 28 can be installed prior to the equipment modules being loaded into place (the decks are broken in order to show the underlying substructure). A deck of this kind can also be placed on the substructure 15 in advance, see figure 15 where a part of such a deck is drawn in and indicated by the number 29.

The decks 27, 28, 29 are reinforced preferably against the underlying substructure with a suitable cross bracing, as is shown in figures 16, 17, where a simple cross frame 30, 31 is used. The extremely simple deck plate structure that is shown here is very flexible in respect of as-built tolerance deviation. It is also very cheap to produce.

Above, the module supporting structures and the substructure are shown and described as a trusswork of pipes. The embodiment of the support system as an open structure is

advantageous. If more compact members are used, for instance a box-like trusswork, optionally with an integrated equipment deck, a substructure of this kind would have to be raised so far above the level of the surface of the ocean and splash zone that the defined regular and cyclic waves could not reach the support structure. Cyclic stress from waves of this kind would otherwise cause fatigue. By constructing the support system as an open structure, it would be permissible for the substructure to be lowered to a level which leaves a smaller clearance above the splash zone. A trusswork of pipes is a very suitable open structure of this kind. Positioned 7-8 metres above calm water and between the columns, the entire top could consequently be lowered correspondingly, as only a small percentage of the regular, large waves would wash against the substructure, with minimal effects of fatigue. The result of this lowering is that the centre of gravity of the top is lowered and wind forces and the momentum from wind forces are reduced.

A trusswork of pipes has the advantage that it could be made in such a way that it transfers stress and maintains the columns, which are exposed to wave stress from 360^{o}, in such a way that all such forces are transferred as pure pressure/tension stress via rigid structural triangles.

Patent Claims

1.

A method of constructing an offshore construction which comprises columns or legs (1-4) which project up through the surface of the water which are reinforced in relation to one another above the surface of the water with a substructure (15), and which further comprises module supporting structures (11,12) on at least two pairs of adjacent columns (1-4), and equipment modules supported on said module supporting structures, characterized in that the substructure (15) is brought in between the columns (1-4) by barge (16), below the equipment modules (13) which are already in position and level with the previously installed module supporting structures (11,12) to which it is connected.

2.

The method according to claim 1, wherein the module supporting structures (11,12) are brought in to place on at least two pairs of adjacent columns (1-4) by means of a barge (10), that thereafter the equipment modules (13) are loaded into place on said module supporting structures (11,12) by means of a barge (14), and then a substructure (15) is brought in between the columns (1-4) by barge (16), below the equipment modules (13) and level with the already installed module supporting structures (11,12), to which it then is connected.

3.

The method according to claim 2, wherein the module supporting structures (11,12) are supported temporarily on the columns (1-4), prior to being secured to the columns, for instance by concreting or welding, or similar.

4.

The method according to claim 2 or 3, wherein the substructure (15) is supported temporarily (17) on the columns (1-4) prior to being secured (connected) to the module supporting structures (11,12).

5.
The method according to claim 4, wherein the substructure (15) is connected to the module supporting structures (11,12) by means of welding in loose parts (18,19) (make-up pieces).

6.
The method according to any one of the preceding claims, wherein the module supporting structures (11,12) are furnished with an overlying deck plate (27,28) prior to the equipment modules (13) being brought into place.

7.
The method according to any one of the preceding claims, wherein the substructure (15) is furnished with an overlying deck plate (29) prior to it being brought in between the columns (1-4) by barge (16).

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The S arch Report)

Application number

GB 9216939.0

Relevant Technical fields

(i) UK Cl (Edition K) E1H (HEA, HEB, HB)

(ii) Int Cl (Edition 5) E02B

Search Examiner

B J PRICE

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search

29 SEPTEMBER 1992

Documents considered relevant following a search in respect of claims 1-7

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

Category	Identity of document and relevant passages	Relevant to claim(s.

Categories of documents

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